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THE VITALITY OF SEED TREATED WITH CARBON BISULPHID.

INTRODUCTION.

The ravages of weevils and other insects in seed grain are well known to every farmer, and are the cause of very serious loss in the value of the seed both for sowing and food purposes. In some of the Southern States, especially, are such ravages so severe that it is often difficult to get sound seed for sowing. The cowpea, corn, wheat, rice, and garden and field peas are the main subjects of attack, but even vegetable seeds are not exempt.

Seeds of the common pea are frequently badly infested with weevils even when grown as far north as Canada. Some seedsmen claim that such insects never injure the embryo, hence do not lessen the sowing value of the seed. This, however, is a serious error; for not only is the embryo frequently injured, sometimes even destroyed, but a large amount of reserve material is consumed, the loss of which greatly weakens the vitality of the young seedlings.

The common remedy advised by entomologists for destroying seed-infesting insects is to treat the seed for twenty-four hours with the fumes of carbon bisulphid at the rate of one pound to the hundred bushels. This chemical when pure is a colorless liquid with a pleasant odor. Upon exposure to the air the carbon and sulphur composing the liquid are separated, each uniting with oxygen, for which they have a stronger affinity than for each other. Thus are formed carbon oxid and sulphur dioxid, the latter being a very poisonous gas with a disagreeable odor.

The statement is made that seed grain may be exposed to these fumes for thirty-six hours without injuring its germinating capacity. So far as we are aware no extended experiments have heretofore been made to test the truth of this statement which, however, is generally accepted and which has very important bearings. For if the treatment recommended is detrimental to the germinating power of the seed, one by adopting it not only would lose his seed, but what is far more serious, would be subjected to delay in waiting for it to come up and then be under the necessity of resowing.

In addition to treating seed to kill insects it is sometimes desirable, as in the case of cotton, for instance, to fumigate imported seed to avoid any risk of the introduction of disease germs. Carbon bisulphid is also used for this purpose, and it is exceedingly important to know whether the fumigating process is likely to injure the vitality of such seed.

Seeds are protected from external injury by a skin or coat which is thicker and more impermeable in some kinds than in others. Further protection is afforded to some species by the fact that their embryo or germ is surrounded by a firm mass of food material composed of starch and various proteid or oily substances. Sometimes this material is deposited wholly in the thickened seed leaves or cotyledons as in the case of the pea. On the other hand the embryo or "chit" of corn, rye, wheat, barley and other grains lies upon the surface just below the coat. Such seeds are more susceptible to injury. Owing to these differences it is necessary to test the effect of the carbon bisulphid upon each of the kinds which for any reason require treatment.

The length of time seeds must be treated with the fumes of carbon bisulphid depends not only upon the resistant power of the insect, but also upon its method of attack. In the case of the pea weevil the larva is embedded within the immature seed, becoming entirely surrounded by the seed coat during its development, hence a treatment prolonged over twenty-four hours may be necessary to destroy the weevils.

COMMERCIAL METHOD OF TREATING SEED WITH CARBON BISULPHID.

Seedsmen treat peas and other "buggy" seeds on a large scale by placing the bags containing the seeds in a fireproof, practically airtight building devoted to that purpose, setting shallow pans holding carbon bisulphid in various parts of the room near the ceiling. After being thus subjected to the fumes for about twenty-four, sometimes as long as forty-eight hours, the room is opened and thoroughly aired.

Some writers have advocated pouring the liquid through a pipe inserted into the center of the bulk of seeds; others suggest the use of a ball of cotton, soaked with the chemical and plunged into the middle of the pile of seeds. Both of these methods are open to objection owing to the fact that the liquid comes in direct contact with some of the seed which takes it up readily, rendering such seed extremely liable to injury from the water which is left behind, if not from a superabundance of the gas itself. Furthermore, carbon bisulphid is a very heavy gas and the upper stratum of seeds treated in either of these ways is likely to receive too little of the fumes to destroy the insects.

Our experiments were made with thirty-three different varieties of grains and vegetables, five of cotton, two of peas, three of Indian

corn, two of rice, two of common garden beans, two of Kafir corn, two of barley, two of wheat, one of oats, etc. In all the experiments only sound seeds were taken, being, so far as possible, from a single stock in each case. Two lots of treated seeds each containing 200 seeds of the larger species and 100 of the smaller kinds were used. Similar lots of untreated seeds were employed as checks.

EXPERIMENTS IN A SATURATED ATMOSPHERE OF CARBON BISULPHID.

In the first series of experiments the seeds were placed in shallow glass vessels, resting on a plate of ground glass covered with a bell jar containing a saturated atmosphere of carbon bisulphid. At the end of 48 hours the seeds were transferred to the germinating chamber, in which were placed also the check lots of untreated seed.

The following table gives in detail the result of the experiment, the figures representing the averages of the germination of the two lots of each kind, both of treated and untreated seed.

Name of Seed.	Per cent Germinated.	
	Treated 48 hours.	Untreated.
Peas:		
"900 to 1" *	100	99
Champion of England	99	96
Black-eyed Marrowfat	95	95
Cotton:		
Jeff Welborn's Pet	93	90
Texas Storm Proof	94	92
Drake's Cluster	89	86
Peterkin	78	81
Peerless	93	94
Beans:		
Golden Cluster Wax Pole	98	99
Currie's Rust Proof	99	100
Lima, Challenger Pole	85	86
Kafir Corn:		
White	100	99
Red	97	97
Turnip, Early White Flat Dutch	84	86.5
Buckwheat, Japanese	98	100
Cauliflower, Early Snowball	89.5	94
Pumpkin, Early Sugar	91	93
Cabbage, Early Jersey Wakefield	85	92
Oats, Winter Turf	78	76
Cowpea, Black-eyed	99	97
Barley, Salzer's	73	99
Rye, University of Minnesota, No. 2	13	98
Wheat, Wellman's Fife	70	99
Corn:		
Field, Waterloo Dent	54	94
Sweet, Egyptian	82	96
Clover, Crimson	80	97.5
Millet, Hog	67.5	96
Rice:		
Flinty Rough	78	94
Chalky Rough	89	98

* Previously treated by the seedsman.

The following seeds, as seen above, were uninjured by this severe test, the germinating percentages of both treated and untreated seed being practically the same: Peas, cotton, beans, Kafir corn, buckwheat, turnip, cabbage, cauliflower, pumpkin, cowpea, and oats. It is safe, therefore, to conclude that none of the ordinary methods of treating these seeds with carbon bisulphid will impair their vitality.

On the other hand, the germinative ability was decreased in barley, rye, wheat, corn, crimson clover, millet, and rice, the difference between the treated and untreated seed varying from 85 per cent in the case of rye to 9 per cent in the chalky rice. With the exception of crimson clover, whose seed is much more tender than that of other clovers, all of the injured kinds belong to the grass family, oats alone of this group showing no injury. This resistant character of the oats is easily explained from the nature of its covering.

This method was an extreme one and represents conditions which would probably never be attained in actual practice. Here each seed, being exposed to a thoroughly saturated atmosphere of the chemical, had ample opportunity to imbibe as much of the vapor as it was capable of retaining. It is reasonable to suppose that seeds whose vitality was not affected by a 48-hour test of this kind, would be in no danger of deterioration in this respect from any treatment given them in ordinary practice.

The varieties which were damaged by the 48 hours' treatment were then subjected to another test of 24 hours' duration. As appears in the table, some of the varieties suffered no deterioration whatever in vitality with the 24-hours' treatment, while there was a marked decrease in the amount of injury in all of them.

Name of Seed.	Per cent Germinated.	
	Treated 24 hours.	Untreated.
Barley, Salzer's	87	98
Rye, University of Minnesota No. 2	54	95
Wheat, Wellman's Fife	99	97.5
Corn:		
Field, Waterloo Dent	92	93
Sweet, Egyptian	90	95
Clover, Crimson	90.5	96.5
Millet, Hog	79	96.5
Rice:		
Flinty Rough	88	88.5
Chalky Rough	94	93

Rye proved the most susceptible to injury, with a difference of 41 per cent between treated and untreated seed. Millet showed 17.5 per cent, barley 11 per cent, and crimson clover 6.5 per cent difference. All differences in germination tests amounting to 5 per cent or less

may be attributed to variation in the quality of each lot of seed used, and no conclusions should be drawn from them with respect to the effect of the treatment.

EXPERIMENTS ON GRAIN IN BULK.

In order to ascertain whether similar injury to the seeds named in the foregoing table would result from treatment in bulk, one bushel each of wheat, rye, barley, and field corn were subjected to a second series of experiments. One bushel of each kind of grain was placed in an air-tight bin for twenty-four hours. Upon the surface of the grain were shallow glass vessels containing carbon bisulphid in the proportion of one pound to one hundred bushels, as recommended by the Division of Entomology of this Department.* At the close of the 24 hours lots of each variety of seed, both treated and untreated, were germinated in duplicate. The averages of these tests are given in the following table.

Name of Seed.	Per cent Germinated.	
	Treated 24 hours.	Untreated.
Corn (Field), Hickory King	97.5	98.5
Rye, Winter	91	90
Barley	97.5	98
Wheat, Jones' Winter Fife	98	97.5

CONCLUSIONS.

It will thus be seen that no appreciable difference in the vitality of wheat, corn, barley, or rye results from treating the seed in bulk with carbon bisulphid for 24 hours at the rate of one pound of the chemical to one hundred bushels of the grain.

In general, seeds of cotton, peas, beans, buckwheat, oats, the cabbage family, and cowpeas will endure the most severe treatment with the fumes of carbon bisulphid without their germination being injured to any appreciable extent. On the other hand, seeds of corn, wheat, rye, and other crops belonging to the grass family (except Kafir corn and oats) should be treated with caution, as serious deterioration in vitality is likely to result from excessive exposure to the gas.

*F. H. Chittenden in the Yearbook of the Department of Agriculture, 1894, pp. 293–4.

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